

## CLAIMS

### What is Claimed

1. An electronic module disposed within a housing of an electrically powered tool, the module comprising:
  - a first layer of electrical insulation between a voltage source and the power tool housing; and
  - a second layer of electrical insulation between the voltage source and the power tool housing, the second layer disposed between the first layer and the power tool housing;
  - the first and second layers combining to provide a predetermined minimum amount of electrical insulation between the voltage source and the power tool housing.
2. The electronic module of Claim 1 further comprising a third layer of insulation between the voltage source and the power tool housing, the third layer disposed between the first layer and the second layer, wherein the first, second and third layers combine to provide a predetermined minimum amount of electrical insulation between the line voltage source and the power tool housing.
3. The electronic module of Claim 2, wherein the combination of the first layer and the third layer provide at least approximately 3750 volts of insulation between the voltage source and the power tool housing.
4. The electronic module of Claim 2, wherein the combination of the first layer and the second layer provide at least approximately 3750 volts of insulation between the voltage source and the power tool housing.
5. The electronic module of Claim 2, wherein the combination of the second layer and the third layer provide at least approximately 3750 volts of insulation between the voltage source and the power tool housing.
6. The electronic module of Claim 2, wherein the first layer comprises a power device coupled to the voltage source.

7. The electronic module of Claim 6, wherein the second layer comprises a thermal pad disposed between a cover of the electronic module and the power tool housing.

8. The electronic module of Claim 6, wherein the second layer comprises a thermal pad disposed between the electronic module cover and the power device.

9. The electronic module of Claim 7, wherein the third layer comprises an insulator disposed between the power device and the thermal pad.

10. The electronic module of Claim 6 further comprising a bridge support, the bridge support comprising a first wall and a second wall to form a receptacle to receive the power device therewithin.

11. The electronic module of Claim 10 wherein the bridge support further comprising a first post and a second post spaced apart from one another, the first post and the second post adapted to secure the power device within the module.

12. The electronic module of Claim 6 further comprising a circuit board, the circuit board being fixedly coupled to the power device.

13. The electronic module of Claim 12, wherein the module further comprises a module housing, and a layer of potting compound disposed within the module housing to support the circuit board within the module housing.

14. The electronic module of Claim 13 wherein the potting compound is placed within the module housing to fill voids within the module housing after the electronic module assembly is fully assembled.

15. An electrically powered tool, said power tool comprising an electronic control module disposed within a housing of the power tool, the electronic module comprising:

a first layer of electrical insulation between a line voltage and the power tool housing, the line voltage for providing power to the power tool; and

a second layer of electrical insulation between the line voltage and the power tool housing, the second layer disposed between the first layer and the power tool housing;

the first and second layers combining to provide a predetermined minimum amount of electrical insulation between the line voltage and the power tool housing.

16. The power tool of Claim 15, wherein the electronic module further comprises a third layer of insulation between the voltage source and the power tool housing, the third layer disposed the first layer and the second layer, wherein the first, second and third layers combine to provide a predetermined minimum amount of electrical insulation between the line voltage source and the power tool housing.

17. The power tool of Claim 16, wherein the combination of the first layer and the second layer provide at least approximately 3750 volts of insulation between the line voltage and the power tool housing.

18. The power tool of Claim 16, wherein the combination of the first layer and the third layer provide at least approximately 3750 volts of insulation between the line voltage and the power tool housing.

19. The power tool of Claim 16, wherein the combination of the second layer and the third layer provide at least approximately 3750 volts of insulation between the line voltage and the power tool housing.

20. The power tool of Claim 16, wherein the first layer comprises a power device coupled to the voltage source.

21. The power tool of Claim 20, wherein the second layer comprises a thermal pad disposed between the power device and a control module cover.

22. The power tool of Claim 20, wherein the second layer comprises a thermal pad disposed between the control module cover and the power tool housing.

23. The power tool of Claim 21, wherein the third layer comprises an insulator disposed between the power device and the thermal pad.

24. The power tool of Claim 20, wherein the control module further comprises a connection mechanism comprising:

a first post on a first side of the power device;

a second post on a second side of the power device; and

a bridge portion connecting the first post and the second post, the posts containing threads and securing a first screw and a second screw, respectively.

25. The power tool of Claim 24 wherein the bridge portion of the connection mechanism holds the power device and the thermal pad against the control module cover when the first screw and the second screw are tightened.

26. The power tool of Claim 25 wherein the thermal pad is compressed to a minimum thickness of 1 mm.

27. The power tool of Claim 15 further comprising a circuit board, the circuit board contacting the power device within the control module.

28. The power tool of Claim 27 further comprising a potting compound, the potting compound providing a foundation to secure the circuit board within the control module.

29. An electrically isolated, triple insulated electronic control module for use in a power tool, the electronic control module comprising:

- a housing;

- a cover that covers an opening of the housing;

- a power device having a first side and a second side, the power device second side facing the cover, the power device first side situated on a first side of a bridge portion, the bridge portion forming a receptacle to receive the power device therewithin, a first post and a second post linked to the cover by a first fastener and a second fastener, respectively;

- an insulator having a first side and a second side, the insulator first side facing the cover and the insulator second side situated against the second side of the power device;

- a thermal pad having a first side and a second side, the thermal pad first side situated against a housing of the power tool and the thermal pad second side situated against the cover, the first fastener and the second fastener holding the bridge portion, the power device and the insulator against the module housing cover; and

- a circuit board having a first side and a second side, the first side of the circuit board situated against a second side of the bridge portion, and the second side of the circuit board situated against a layer of potting compound which rests upon the bottom portion of the module housing.

30. An electrically isolated, triple insulated electronic control module for use in a power tool, the electronic control module comprising:

- a housing;

- a cover that covers an opening of the housing;

- a power device having a first side and a second side, the power device second side facing the cover, the power device first side situated on a first side of a bridge portion, the bridge portion forming a receptacle to receive the power device therewithin, a first post and a second post linked to the cover by a first fastener and a second fastener, respectively;

- an insulator having a first side and a second side, the insulator first side facing the cover and the insulator second side situated against the second side of the power device;

- a thermal pad having a first side and a second side, the thermal pad first side situated against the cover and the thermal pad second side situated against the first side of the insulator, the first fastener and the second fastener holding the bridge portion, the power device, the insulator, and the thermal pad against the module housing cover; and

- a circuit board having a first side and a second side, the first side of the circuit board situated against a second side of the bridge portion, and the second side of the circuit board situated against a layer of potting compound which rests upon the bottom portion of the module housing.

31. An electrically isolated, double insulated electronic control module for use in a power tool, the electronic control module comprising:
- a module housing;
  - a cover that covers an opening of the module housing;
  - a power device having a first side and a second side, the power device second side facing the cover, the power device first side situated on a first side of a bridge portion, the bridge portion forming a receptacle to receive the power device therewithin, a first post and a second post linked to the cover by a first fastener and a second fastener, respectively;
  - a thermal pad having a first side and a second side, the first side situated against the cover and the second side situated against a power tool housing, the first fastener and the second fastener holding the bridge portion and the power device against the cover; and
  - a circuit board having a first side and a second side, the first side of the circuit board situated against a second side of the bridge portion, and the second side of the circuit board situated against a layer of potting compound which rests upon the bottom portion of the module housing.

32. A method for isolating a line voltage applied to a power tool to power the power tool, from an external housing of the power tool, wherein the power tool includes an internally mounted component responsive to the line voltage, the method comprising:

implementing a first level of electrical insulation between a power cord of the power tool and the external housing of the power tool; and

implementing a second level of electrical insulation between the power cord and the housing of the power tool.

33. The method of claim 32, wherein implementing the first level of electrical insulation includes providing a power generating component disposed within the internally mounted component.

34. The method of claim 33, wherein implementing the second level of electrical insulation includes disposing a layer of electrically insulative material between the power generating component a cover of the internally mounted component.

35. The method of claim 32, wherein implementing the second level of electrical insulation includes disposing a layer of electrically insulative material disposed between a cover of the internally mounted component and the housing of the power tool.

36. The method of 32, further comprising implementing a third level of electrical insulation between the power cord and the housing of the power tool to further insulate the line voltage from the housing of the power tool.



37. A method of operating a power tool comprising:  
supplying a line voltage to a module at least partially disposed  
within a housing of the power tool;  
using a power controlling component disposed within the module to  
provide a first level of electrical isolation between the line voltage and the tool  
housing; and  
using a layer of electrically insulative material between a cover of  
the module and the power generating component to provide an independent,  
second level of electrical isolation between the line voltage and the tool housing.

38. The method of claim 37, further comprising using an additional  
layer of electrically insulative material disposed within the module for providing a  
third, independent layer of electrical isolation between the line voltage and the  
tool housing.

39. A method of operating a power tool comprising:
- supplying a line voltage to a module at least partially disposed within a housing of the power tool;
  - using a power controlling component disposed within the module to provide a first level of electrical isolation between the line voltage and the tool housing; and
  - using a layer of electrically insulative material between a cover of the module and the power tool housing to provide an independent, second level of electrical isolation between the line voltage and the tool housing.
40. The method of claim 39, further comprising using an additional layer of electrically insulative material disposed within the module for providing a third, independent layer of electrical isolation between the line voltage and the tool housing.

41. A method for isolating a line voltage from a power tool housing, wherein the line voltage is used to power a motor within the power tool, the method comprising:

providing a layer of electrical insulation between the line voltage and an external tab of a power device included in a module connectable to the line voltage and the power tool housing, thereby providing a first layer of electrical insulation between the line voltage and the power tool housing;

disposing a thermal pad between the power tool housing and the external tab of the power device, thereby providing a second layer of electrical insulation between the line voltage and the power tool housing; and

connecting the module to an internal surface of the power tool such that the power tool housing functions as a heat sink for the module.

42. The method of Claim 41, wherein providing a layer of electrical insulation between the line voltage and the external tab comprises utilizing at least one internal electrically isolative property of the power device to provide the first layer of electrical insulation.

43. The method of Claim 41 further comprising combining the first and second layers to provide a predetermined minimum amount of electrical insulation between the line voltage source and the power tool housing.

44. The method of Claim 41, wherein disposing a thermal pad between the power tool housing and the external tab of the power device comprises

securing the power device within a bridge support;

disposing the thermal pad between a cover of the module and the external tab; and

securing the cover to the bridge support such that the thermal pad is compressed between the external tab and the cover.

45. The method of Claim 41, wherein disposing a thermal pad between the power tool housing and the external tab of the power device comprises

disposing the thermal pad between a cover of the module and the power tool housing.

46. The method of Claim 41 further comprising disposing an insulator between the external tab and the thermal pad, thereby providing a third layer of electrical isolation between the line voltage and the power tool housing.

47. The method of Claim 46 further comprising providing approximately 3750 volts of insulation between the line voltage and the power tool housing utilizing any two of the first layer, the second layer, and the third layer.

48. An electronic module adapted to provide electrical insulation between a power source a housing of a power tool, the module comprising:

a means for providing a layer of electrical insulation between the power source and a component of a power device included in the module and responsive to the power source, thereby providing a first layer of electrical insulation between the power source and the power tool housing;

a means for providing a second layer of electrical insulation between the power source and the power tool housing; and

a means for connecting the module to an internal surface of the power tool housing, thereby utilizing the power tool housing as a heat sink for the module.

49. The electronic module of Claim 48, wherein the first and second layers combine to provide a predetermined minimum amount of electrical insulation between the power source and the power tool housing.

50. The electronic module of Claim 48 wherein the means for providing the first layer comprises the power device.

51. The electronic module of Claim 50, wherein the means for providing the second layer comprises a thermal pad disposed between a module cover and the power tool housing.

52. The electronic module of Claim 50, wherein the means for providing the second layer comprises a thermal pad disposed between the power device and a module cover.

53. The electronic module of Claim 52 further comprising a means for securing the thermal pad between the component of the power device and the cover.

54. The electronic module of Claim 53, wherein the means for securing the thermal pad between the component and the cover comprises a bridge adapted to retain the power device and couple to the cover such that the thermal pad is compressed between the component and the cover.

55. The electronic module of Claim 53 further comprising a means for providing a third layer of insulation between the power device and the cover, wherein the first, second and third layers combine to provide a predetermined minimum amount of electrical insulation between the line voltage source and the power tool housing.

56. The electronic module of Claim 55, wherein the means for providing the third layer comprises a layer of electrically insulative material.

57. The electronic module of Claim 48 further comprising a means for providing a third layer of electrical insulation between the means for providing the first layer of electrical insulation and the means for providing the second layer of electrical insulation.

58. The electronic module of Claim 57, wherein the means for providing the third layer comprises a layer of electrically insulative material.

59. An electrically powered tool comprising:  
a housing;  
a motor supported within the housing for providing torque to the power tool; and

an electronic control module responsive to a line voltage and disposed within a housing of the power tool such that the tool housing acts as a heat sink for the electronic control module, wherein the electronic control module comprises:

a power device disposed in the electronic control module, the power device being responsive to the line voltage and providing a first layer of electrical insulation between the line voltage and tool housing; and

a thermal pad, wherein the thermal pad is disposed between the portion of the power device and the tool housing, the thermal pad providing a second layer of electrical insulation between the line voltage and the tool housing, such that the first and second layers combine to provide a predetermined minimum amount of electrical insulation between the line voltage and the tool housing.

60. The power tool of Claim 59, wherein the thermal pad is disposed between a module cover and the power tool housing.

61. The power tool of Claim 59, wherein the thermal pad is disposed between the power device and a module cover.

62. The power tool of Claim 61, wherein the electronic control module further comprises an insulator disposed between the portion of the power device and the thermal pad, the insulator providing a third layer of insulation between the power tab and the thermal pad, wherein the combination of the first, second and third layers provide a predetermined minimum amount of electrical insulation between the line voltage and the tool housing.

63. The power tool of Claim 62, wherein the electronic control module further comprises a bridge adapted to retain the power device and couple to the

cover such that the thermal pad is compressed between the insulator and the cover.



64. A module for an electrically powered tool, said module comprising:  
a power device responsive to a voltage source and disposed within the module;

a first layer of electrical insulation disposed between the voltage source and a housing of the power tool; and

a thermal device thermally connecting the power device to the housing of the power tool and providing a second layer of insulation between the voltage source and the housing of the power tool.

65. The module of Claim 64, wherein the first layer of electrical insulation comprises at least one internal electrically isolative property of the power device.

66. The module of Claim 64, wherein the thermal device comprises a thermal pad.

67. The module of Claim 64, wherein the first layer and the second layer combine to provide at least approximately 3750 volts of insulation between the voltage source and the power tool housing.

68. The module of Claim 64 wherein, the thermal device connects the power device to the housing of the power tool such that the housing of the power tool provides a heat sink for the power device.

69. A module mounted to a housing of an electrically powered tool, said module comprising:

a power device responsive to a voltage source, the power device having at least one internal electrically isolative property that provides a first layer of electrical isolation between the voltage source and the tool housing; and

a second layer of electrical isolation between the voltage source and the tool housing, the second layer comprising at least one of an electrically insulative thermal pad and an electrically insulative dielectric layer,

wherein the combination of the first and second layers provide at least approximately 3750 volts of electrical insulation between the voltage source and the tool housing.

70. The module of Claim 69, wherein the second layer is disposed between the power device and the tool housing.

71. The module of Claim 69, wherein the module comprises the thermal pad and the dielectric layer, thereby providing the second and a third layer of electrical isolation between the voltage source and the tool housing.

72. The module of Claim 71, wherein the combination of any two of the first, second and third layers provides at least approximately 3750 volts of electrical insulation between the voltage source and the tool housing.

73. The module of Claim 69, wherein the module is mounted to the housing of the power tool such that the housing of the power tool provides a heat sink for the power device.